Spokane River Toxics Reduction Strategy

DEPARTMENT OF ECOLOGY
State of Washington

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Cover photo: The Spokane near Gonzaga University looking west

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Spokane River Toxics *Reduction Strategy*

by;

Communication and Education Program
Water Quality Program
Environmental Assessment Program
Hazardous Waste and Toxics Reduction Program
Toxic Cleanup Program

Washington State Department of Ecology
Olympia, Washington

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Table of Contents

Page

Acknowledgements iv

Introduction 1

Descriptions of Toxics of Concern in Spokane 3
- PCBs 3
- PBDEs 3
- Dioxins/Furans 3
- Metals 3
- Pharmaceuticals and personal care products 4

What We've Accomplished 7
- Progress has been made to clean up toxic, and we have seen results 7
- Environmental assessment—getting the science right 8
  - Past studies 8
- Statewide efforts to reduce toxics 8
- Local efforts 9
  - Cleaning up toxic metals from Idaho's mining district 9
  - Other toxic metals cleanups 10
  - Cleaning up PCB contamination 10

Toxics Reduction Strategy for Current and Future Work 13
- Environmental assessment 14
  - Current and future studies 14
  - Urban Waters Initiative 14
- Water Quality Program work 15
  - Wastewater permitting 16
  - Managing stormwater 17
  - City of Spokane Stormwater PCB Adaptive Management Plan 17
- Toxics Cleanup Program 18
- Hazardous Waste and Toxics Reduction 19
  - Inspections and Technical Assistance 19
- Ecology's Spill Response Program's spill prevention and cleanup 19
- Communications 20
- Connecting people with tools 20
  - Residents, businesses, and government 20
  - Ecology Studies 23

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Introduction

This document is the Washington Department of Ecology's (Ecology) strategy, or "road map," for reducing and removing toxic contamination in water, water sediments and soil in the Spokane River watershed in Washington State. It also recounts the major actions that have already taken place. The strategy elements described here span across multiple Ecology programs and address toxic substances in the products we buy to cleanups of legacy pollutants in the Spokane community. This is a *living* document; we will build on this road map, adding new initiatives, strategies and successes while it is being implemented.

Toxic chemicals in our environment are a high priority for Ecology. Toxic pollution is complicated, especially difficult to find and remove, and even though in many cases the substances are no longer manufactured, they continue to persist in the environment and are found everywhere. They pollute the Spokane River because they are in wastewater, stormwater and much more diffuse sources. They leave contaminated soils where the chemicals were used in the past. Residents, visitors, and aquatic creatures can be exposed to the pollution. Ecology's Eastern Regional Office is working with the community to prevent the release of toxics into our environment, limit exposure, and clean up the worst spots along the river.

In 2005, the Department of Ecology reached a 1990 legislative goal of reducing hazardous waste in the state by 50 percent. Even with that achievement, concerns about toxic chemicals in the environment continue to grow because toxic chemicals are embedded in the products we buy and use every day – from household cleaners to yard products to durable goods. The risk from toxic chemicals doesn't begin with just a leaking drum at an industrial site. It also begins when we buy and use products that contain toxic chemicals.

Spokane Falls

Many of these chemicals end up in our aquatic systems, such as rivers, where they persist and travel up through the food chain, in some cases having ongoing impacts to humans and the environment.

Ecology is working with local citizens, businesses, city and county governments and environmental organizations to identify and reduce toxic pollution in the Spokane River.

We are doing this work together with many community partners:

- City of Spokane and other municipalities such as Liberty Lake.
- Spokane County.
- Idaho's Department of Environmental Quality and the cities of Post Falls, Hayden Lake, and Coeur d'Alene.
- U.S. Environmental Protection Agency.
- Private companies that discharge wastewater into the river.
- Local environmental advocacy groups
- Coeur d'Alene Tribal government.
- Spokane Tribe of Indians.
- Spokane Regional Health District.

Not only are we coordinating with other agencies and organizations, but within Ecology's Eastern Regional Office our many different programs are working closely together to address toxics. The programs include Water Quality, Toxics Cleanup, Water Resources, Waste 2 Resources, and Hazardous Waste and Toxics Reduction.

As stated, toxic chemicals and metals are everywhere—in the air from other parts of the world, in our bodies, in the clothes we wear, the chair we sit on, and in our water. As much as we try to clean them up and prevent their release, the job is one we all need to share. Beyond the strategies described in this document, we all must change the way we shop, change the products we use, and take personal responsibility for the way we use and dispose of chemicals when we have to use them. Only then can we make meaningful progress in reducing toxics to the Spokane River.

Spokane Falls

Descriptions of Toxics of Concern in Spokane

PCBs

Polychlorinated biphenyls (PCBs) are a family of human-made, chlorinated chemical compounds that were once used in a variety of applications including as insulating fluids for electric transformers and capacitors. They were also used in plasticizers, paint additives, adhesives, inks and carbonless (mimeograph) paper, lubricants, and as heat transfer and hydraulic fluids. Commercial production of PCBs was stopped in 1977 because of concerns about toxicity and persistence in the environment. They are persistent, bioaccumulative, and toxic (PBT). PCBs in food, particularly fish, are the main way that people are exposed. Low-level exposure to PCBs can affect the immune system, and exposure in the womb can cause learning deficits later in life.

PBDEs

Polybrominated diphenyl ethers (PBDEs) are a family of chemicals used as flame retardants in plastic and foam products such as electronic enclosures, wire insulation, adhesives, textile coatings, foam cushions, and carpet padding. Increasing concentrations of PBDEs in humans and wildlife worldwide continue to raise concerns about their health effects. The highest levels of PBDE in human tissue have been found in the U.S. and Canada (Ecology and DOH, 2006). The release of PBDEs from products in our homes is thought to be a key way that PBDEs get into our bodies. No definite information is available on health effects of PBDEs in people. Laboratory tests in animals suggest that high concentrations of PBDEs may cause neurobehavioral alterations and affect the immune system.

Dioxins/Furans

Dioxins and furans, or polychlorinated dibenzo-p-dioxins and -furans, are a family of chemicals that are not produced intentionally but are byproducts of combustion (trash, wood and other fossil fuels), chlorine bleaching in paper production, and chemical and pesticide manufacturing. Agent Orange, used as a defoliant in the Vietnam War, contained dioxins (ATSDR 2006). People exposed to large amounts of dioxin can develop chloracne, which is a severe skin disease with acne-like lesions that occur mainly on the face and upper body. Changes in blood and urine that may indicate liver damage also are seen in people. Long-term exposure to dioxins is associated with increased risk of getting cancer.

Metals

- **Arsenic**—Exposure to higher than average levels of arsenic occurs mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts, redness and swelling. Many common arsenic compounds can dissolve in water. Most of the arsenic in water will ultimately end up

in soil or sediment. Fish and shellfish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful.

- **Cadmium**—Cadmium is a natural element in the earth's crust. It is usually found as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide). Most cadmium used in the United States is extracted during the production of other metals like zinc, lead, and copper. Cadmium does not corrode easily and has many uses, including batteries, pigments, metal coatings, and plastics. Usually, the general population is exposed to cadmium when people breathe cigarette smoke or eat cadmium-contaminated foods. Cadmium damages the kidneys, lungs, and bones.

- **Lead**—Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing. Children can be exposed to lead in indoor dust from deteriorating paint or by playing in contaminated soil. Exposure to lead can also happen from breathing workplace air or dust, eating contaminated foods, or drinking contaminated water. Lead can damage the nervous system, kidneys, and reproductive system.

- **Zinc**—Zinc is a naturally occurring element that is also pervasive in urban and industrial settings. Zinc is found everywhere there is galvanized metal -- from cyclone fences to gutters and metal roofs. Zinc is also found in tires, motor oils and in hydraulic fluids. Zinc from stormwater harms fish and other aquatic life. Zinc can bind to fish gills and cause suffocation. When zinc becomes dissolved in water, it is harmful even at relatively low concentrations to threatened and endangered salmon and aquatic life. Our exposure to large amounts of zinc can cause stomach cramps, anemia, and changes in cholesterol levels.

  Zinc compounds are widely used in industry to make paint, rubber, dyes, wood preservatives, and ointments. Some is released into the environment by natural processes, but most comes from human activities like mining, steel production, coal burning, and burning of waste. Depending on the type of soil, some zinc compounds can move into the groundwater and into lakes, streams, and rivers. Most of the zinc in soil stays bound to soil particles and does not dissolve in water. It builds up in fish and other organisms, but it does not build up in plants.

Pharmaceuticals and personal care products

Pharmaceuticals and personal care products (PPCPs) are an emerging environmental and human health issue. Pharmaceuticals and personal care products refer to any product used by individuals for personal health or cosmetic reasons. These include any substance intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease.

PPCPs are used daily by virtually every human, and so are now found throughout our environment. They enter the environment as they pass through the human body or when unwanted PPCPs are disposed in the trash or down the drain. Other significant sources include use for livestock, aquaculture, pets, and agriculture. This also includes products used to enhance

the growth or health of livestock. Personal care products contain many different chemicals, and data vary greatly about human health and environmental effects.

PPCPs are present at low concentrations in lakes and streams, groundwater, soil, sediments, marine water, and drinking water. Researchers monitoring the environment find PPCPs at higher levels where domestic wastewater is discharged.

The human health effects resulting from daily exposure to low concentrations of PPCPs are unclear. Researchers suspect that hormones and other chemicals used in PPCPs may be responsible for effects on wildlife including feminization of male fish, sluggish activity, or reduced appetite.

Conventional wastewater treatment systems do not do a good job of removing PPCPs from their discharge. Some advanced wastewater treatment processes exist that are more effective in removing these contaminants; however, these treatment processes are less commonly used. No single treatment process will completely remove all PPCPs from wastewater.

Prevention strategies, such as pharmaceutical take-back programs, are excellent tools, but they only address a fraction of the problem. This kind of contamination cannot be eliminated; it must be managed. A combination of prevention strategies combined with advanced wastewater treatment could reduce the amount of PPCPs in the environment.

People can do their part by storing medicines safely, using take-back medicine programs, and supporting the creation of statewide and national medicine take-back programs. Do not flush unused medicines or personal care products down the drain. For more information on proper medicine disposal, go to http://earth911.com and/or http://www.takebackyourmeds.org.

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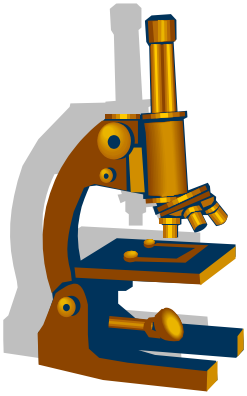
What We've Accomplished

Spokane Falls in the middle of the city during spring runoff

Progress has been made to clean up toxics, and we have seen results

Before outlining Ecology's strategy for toxic chemicals in the Spokane River watershed, you will see here summaries of statewide and local on-the-ground cleanup work that has already been accomplished. These and other local actions are responsible for reducing toxics in the Spokane River to a substantial degree compared to the past 100 years.

Environmental assessment—getting the science right



Ecology's Environmental Assessment Program (EAP) has conducted research over the years to tell us where problems exist. Much of our work is based on this scientific work. The program conducts monitoring on many persistent bioaccumulative (accumulates in tissues) toxics (PBTs) and conducts studies on the river to identify sources and track trends.

Past studies

In past years the Environmental Assessment Program has published studies on PCBs, flame retardants, dioxins/furans, pesticides and heavy metals in fish tissue and in the Spokane River's water. The bibliography of toxic studies through 2012 starts on page 23.

Statewide efforts to reduce toxics

Reducing toxics at the source (i.e., at the point of manufacture in consumer and industrial products) is an important component of this strategy and requires a statewide effort. Statewide, Ecology has taken concrete actions to target certain pollutants at the source. Here are some examples:

- Washington state successfully locked in the first-ever ban on the persistent, bioaccumulative (builds up in tissues) flame-retardant, Deca-BDE, that gets into the food chain and into human mothers' milk.

- The Department of Ecology has developed three Chemical Action Plans (CAPs) so far, and more will be developed. These are part of Ecology's Toxics Initiative. See the regulation here: https://fortress.wa.gov/ecy/publications/publications/wac173333.pdf

- A CAP is a comprehensive plan to identify, characterize and evaluate all uses and releases of a specific PBT (persistent bioaccumulative toxic chemical), a group of PBTs or metals of concern. A CAP is a plan, not legislation or a rule. It recommends actions to protect human health and the environment. Some of the recommendations may lead to new legislation or rules. These would go through the normal legislative or rulemaking process.

- Go to this web site to see Chemical Action Plans for lead, mercury and PBDEs (flame retardants): www.ecy.wa.gov/programs/swfa/pbt/

- Ecology's Beyond Waste Plan sets a direction for waste management in Washington State over the next 30 years and lists specific recommendations. It sets the framework for the Hazardous Waste and Toxics Reduction Program's work plan. See the Beyond Waste Plan at: www.ecy.wa.gov/beyondwaste/

Moving “beyond waste” will help us protect the environment, human health, and our state's economic development. Moving “beyond waste” to re-use and reduce materials use, especially toxic materials, will take many years.

- Working with manufacturers, retailers, collectors, transporters, processors, and local governments, Ecology has been able to launch E-cycle Washington. Households, small businesses, schools and school districts, small governments, special purpose districts, and charities have a free, convenient and environmentally responsible recycling program for computers, monitors, laptops, and televisions. Many electronics, especially TVs and computers, contain toxic materials such as PBDEs, lead, cadmium and mercury. Reusing and recycling electronics will keep these toxic materials out of our incinerator, and also recovers valuable resources. The electronic equipment this program collects will be taken apart and separated into materials such as glass, plastic, metal and chemicals. See the law here: https://fortress.wa.gov/ecy/publications/summarypages/0707042.html

More detail on the state’s overall toxics reduction strategy can be found at: www.ecy.wa.gov/toxics/index.htm

Local efforts

Cleaning up toxic metals from Idaho’s mining district

Some toxic metals come from Idaho’s historic mining district, and major work has been done on the federal and state levels to clean them up. In fact, Ecology conducted four cleanup operations and the U.S. Environmental Protection Agency (EPA) conducted one. Four more are under way in 2012. The total amount of contaminated material excavated from these areas included more than 3,000 tons. More than 6,000 tons of clean capping materials were placed over some contaminated areas to prevent people from coming into contact with the toxic metals.

Contaminants from historic mining practices in Idaho’s Coeur d’Alene Basin washed downstream and settled in soil and sediment along certain beaches of the Spokane River. These contaminants, known as heavy metals, include lead, arsenic, zinc, and cadmium. The EPA conducted studies of mining contaminants in the Coeur d’Alene Basin and began a wide-spread cleanup known as the Coeur d’Alene Basin Superfund cleanup. As a result of the studies, and additional testing by Ecology, nine shoreline areas in Washington State were identified for cleanup.
Cleanup of heavy metals in Spokane River beaches that are now complete:

2006 – Starr Road (EPA and Ecology)
2007 – Island Complex (Ecology)
2007 – Murray Road (Ecology)
2008 – Harvard Road (Ecology)
2009 – Flora Road (Ecology) This site was disturbed during high river flows in 2011 and is being repaired.

See the Spokane River basin section under Toxics Cleanup Activities on Ecology's website for links to details about each of the metals cleanup projects. This link will take you directly there: https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=11591

Other toxic metals cleanups

Kendall Yards (River Front Properties). *More Than 200,000 Tons of Contaminated Soil Removed*. In less than one year, the owners of River Front Properties finished cleaning up several contaminants in soil at the site. The cleanup was conducted in compliance with the U.S. Environmental Protection Agency's (EPA) Brownfields Initiative and Ecology's Voluntary Cleanup Program. Ecology worked alongside other parties including the owners, River Front Properties, LLC and their consultants, the Washington Department of Commerce, the EPA, and the city of Spokane.

The site was placed on Ecology's Hazardous Sites List because of contamination from previous land uses primarily related to the railroad industry. Union Pacific operated a locomotive repair and servicing complex from 1914 to 1955 at the site. Other uses included a plating operation, storage facilities and operation of several county facilities. Contaminants in soil included petroleum product, metals, and materials known as carcinogenic polyaromatic hydrocarbons.

Cleaning up PCB contamination

Ecology tested PCBs in a variety of fish species from the river between 1994 and 2005. Those studies indicate the situation is improving. PCB concentrations have declined some in the last 15 years. Meanwhile, some on-the-ground cleanup activities have been focused on PCBs. Here are examples:

Restoring Donkey Island

2007–Donkey Island
This project is east of the dam in wetlands and backwater channels found on the north bank of the river. Ecology provided oversight as contractors removed PCB-contaminated soil and restored the area with clean sand. Areas disturbed during PCB removal were replanted in the spring of 2007.

2006–Upriver Dam PCB Sediment Site (Avista Development, Inc., and Ecology)
Upriver dam is located along Upriver Drive east of Havana Street. The project begins directly behind the dam and stretches east for nearly one-half mile. Ecology directed contractors for Avista Development, Inc. to place a three-layered cover called an engineered cap over the contaminated sediments on the river bottom. The cap is coal, sand, and gravel and is intended to isolate PCBs and keep contaminants from moving.

Kaiser Aluminum Fabricated Products, now known as Kaiser Aluminum Washington, LLC.
Ecology's Toxics Cleanup Program is working with Kaiser to address PCBs, petroleum and metals contamination at the Kaiser Trentwood site near the river. Kaiser has completed a

Remedial Investigation and Feasibility Study at the site. The purpose of the Remedial Investigation was to gather information to determine the nature and extent of contamination that may be in soil and groundwater. The Feasibility Study evaluated cleanup options to address the identified contamination. Additional interim actions, including treatability studies for PCBs in groundwater will be conducted in the future to gather additional information necessary to select a final remedy for PCBs in groundwater. See this link for details: https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=7093

Ecology's Hazardous Waste and Toxics Reduction Program continues to work with Kaiser to make sure dangerous waste produced from the cleanup activities and from current facility operations is managed appropriately.

2007–Kaiser Trentwood–West Discharge Ravine.
Much of the cleanup was completed in October 2007 at a portion of the Kaiser Trentwood site known as the West Discharge Ravine. The West Discharge Ravine was used as a wastewater conveyance from 1942 until about 1973 when wastewater treatment facilities were upgraded. PCBs and petroleum product in soil were removed in an accelerated process to protect human health and eliminate potential impacts to the river. Over 1,700 tons of PCB and petroleum-contaminated soil were removed from the West Ravine, which included an estimated 250 pounds of PCBs. The area was backfilled with clean soil, graded, and hydro-seeded. Native plants were re-established.

Other projects have been undertaken to reduce PCBs in the environment. The following are examples of projects in the Spokane area that re either adjacent to the river or could affect the river because of contaminated groundwater or contaminated stormwater runoff.

The City Parcel site cleanup on North Cook Street

Many other actions also have been taken that are not listed here. These include formal cleanups of other, smaller contaminated sites; cleaning up old, contaminated landfills and more.

City Parcel site
Ecology's Toxics Cleanup Program completed PCB cleanup at the City Parcel site located at 708 N. Cook St. in Spokane. More than 8,000 tons of PCB-contaminated soil and material were removed from the former transformer recycling and repair facility. See the link below for details: https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=1023.

In addition, Ecology's Urban Waters Program continues to work with the city of Spokane to clean up its stormwater system around City Parcel. This includes storm system clean outs, source tracking, and sealing of drywell secondary piping discharging to the storm drain system.

General Electric
Ecology's Toxics Cleanup Program worked with GE to clean up PCBs at a site located at 4323 E. Mission St. in Spokane. Long-term monitoring is being conducted to determine the effectiveness of the cleanup. See this link for details: https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=1082.

Toxics Reduction Strategy for Current and Future Work

The river at the old Washington Water Power site in downtown Spokane

The major elements of Ecology's toxics reduction strategy are described below, including efforts by the Environmental Assessment, Urban Waters, Water Quality, Toxics Cleanup, and Hazardous Waste and Toxics Reduction programs. The strategy elements include keeping up-to-date with the science, learning from where the toxics are coming, and reducing those upland sources. Other elements include writing new permits for industrial and municipal dischargers and more on-the-ground cleanup work on the beaches or upland sites where toxic pollutants are a threat to the Spokane River.

Environmental assessment

Current and future studies

Ecology is in the process of working with the Spokane River Regional Toxics Task Force to develop a monitoring plan to track the progress being made by efforts to reduce toxic chemicals in the main stem of the Spokane River. The monitoring plan should be ready for use in 2013. (See past studies on page 23.)

Ecology is conducting the following monitoring activities in the main stem of the Spokane River:

- Trend monitoring for particulate lead- Stateline and Nine Mile Dam.

- Ambient water monitoring for arsenic, cadmium, copper, chromium, lead, mercury, nickel, silver and zinc every other month- Stateline.

- Surveying resident fish at the following sites: Plante's Ferry to Upriver Dam, Mission Park, Nine Mile Reservoir, and Upper Lake Spokane to evaluate current levels and providing data to update the Spokane River fish tissue consumption advisory.

- Conducting pilot monitoring for PCBs and PBDEs in water and PCBs, PBDEs, Dioxins, and metals in suspended particulate matter to help design a long term monitoring program for the main stem of the Spokane River.

Urban Waters Initiative

The Urban Waters Initiative is addressing Spokane River contaminants as well as toxic problem areas in the Spokane River basin. The project is comprised of a team of Ecology scientists, technical staff, and specialists from the Spokane Regional Health District. They are sampling stormwater, river water and catch basin sediments, plus visiting businesses along the river to identify sources of toxic chemicals that affect the river. Ecology will work with these sources to eliminate further discharge to the river. Go to: www.ecy.wa.gov/urbanwaters/index.html for more information.

The following are major accomplishments of the Urban Waters Project since since its inception in November 2007. Urban water specialists have:

1. Completed a pilot study in Liberty Lake to isolate contaminant concentrations from residences and industries with no known sources. A report was completed in 2010 (https://fortress.wa.gov/ecy/publications/summarypages/1004027.html). This report identified the basis for a similar effort to trace sources thru sampling and research in the city of Spokane's stormwater and sewer systems.

2. Characterized 11outfalls, looking for the sources of contamination by inspecting and sampling smaller watersheds within the city of Spokane and the city's sanitary sewer system.

3. Identified toxic sources and worked to eliminate those sources within two sub-watersheds in the city, called Union basin and Erie basin. These two basins contribute the highest PCB loads in stormwater to the Spokane River.

4. Worked with the city to transfer some sampling and monitoring responsibility to its stormwater department. Part of this effort involved training the city's staff in sampling technique, chain of custody and making sure the analysis methods were consistent with Ecology's methods.
5. Supplied funding to Ecology headquarters Geographic Information System program for the purpose of developing a web-based tool to help with source tracing and improving transparency and information sharing with stakeholders. This tool will be used by Ecology staff and the Spokane Regional Toxics Taskforce in an effort to further identify sources of toxic pollutants.

6. Designed and built a prototype sediment sampler for gathering samples of sediment in the city of Spokane's stormwater system. This sampler has been subjected to a vigorous validation study comparing it to several other prototypes. Recently it has been accepted as an alternative technology. The device was designed to accomplish the following:

    - Capture a representation of sediment being transported to the river by installing it before a storm event and leaving it in place for the duration of the event.
    - Reduce or eliminate the need for entering confined spaces, by being easily installed and recovered.
    - Offer a low cost/low manpower drain that is reusable and virtually indestructible.
    - Improve capture rate.
    - Capture bedload sediments.
    - Provide adequate sediment for analysis, therefore, defensible data.

7. Partially funded and participated in the Northeast Washington Lakes Background Study for the purpose of establishing background pollutant concentrations in lightly impacted rural lakes.

Spokane Regional Health District and Ecology urban waters specialists have conducted more than 360 business visits in areas of concern through April 2012.

Water Quality Program work

A draft Spokane River water quality improvement plan (or "TMDL" for total maximum daily load) for PCBs was issued for public comment in June 2006 but was not completed because of the need for more data, including more accurate stormwater data, updated fish tissue sampling results, and the consideration of new Spokane Tribe water quality standards for PCBs based on updated fish consumption rates. The new, updated information was incorporated into a document called the Spokane River PCB Source Assessment Report, 2003-2007, which was published in 2011. See it at: (https://fortress.wa.gov/ecy/publications/publications/1103013.pdf).

In addition to the new information, the report contains a review of previous studies, a discussion of PCB concentrations from the Idaho border to the mouth of the river from 2003 through 2007, an assessment of reductions necessary to reduce PCBs from current levels, and general actions various organizations can take and are taking to reduce PCBs.

Spokane community members have expressed significant interest in implementing direct measures right away that reduce all toxics to the Spokane River. This is in part because the community's history with the Spokane River Dissolved Oxygen TMDL, which took 12 years to complete. Ecology agrees that community resources are best spent pursuing measures that will achieve measurable reductions. Accordingly, Ecology is not currently prioritizing the development of a PCB TMDL. However, a PCB TMDL still remains a tool and will be necessary if ongoing toxics reduction strategies do not result in compliance with water quality standards.

Spokane community members have expressed significant interest in implementing direct measures right away that reduce all toxics to the Spokane River. This is in part because the community's history with the Spokane River Dissolved Oxygen TMDL, which took 12 years to complete. Given that the PCB TMDL would establish a near-term target that is almost impossible to achieve, Ecology agrees that community resource are best spent in achieving measurable reductions and is not currently planning to develop a PCB TMDL. However, a PCB TMDL still remains a tool that can be used in the future to achieve water quality standards.

In 2011, Ecology, working in partnership with a diverse group of Spokane River stakeholders, formed the Spokane River Regional Toxics Task Force (task force) under the guidance of a Memorandum of Agreement (http://srrttf.org/). The task force membership works collaboratively to identify and support technical studies, monitoring efforts and public education work.

In 2012, the task force convened the "Spokane River Toxics Workshop #1." A team of national experts spoke about toxics in the Spokane River, work in other watersheds, regulatory frameworks for reducing toxics, stormwater, aerial deposition, and analytical techniques. With the most current and up-to-date information on the management and control of toxics in rivers and watersheds in hand, the task force began to develop a work plan for reducing toxics in the Spokane River.

Wastewater permitting

Five wastewater treatment plants discharge to the Spokane River in Washington: Inland Empire Paper Company, Kaiser (Trentwood), the city of Liberty Lake, Spokane County and the city of Spokane. Wastewater permits place limits on the quantity of toxics and other contaminants that may be discharged to the river without violating state or federal water quality standards. Permits also set other conditions, including monitoring and reporting requirements, spill prevention planning, and other activities to protect water quality.

Dischargers to the Spokane River are required to have a wastewater permit before they are allowed to discharge. The permits are required by the federal government and are called National Pollutant Discharge Elimination System (NPDES) permits.

New permits were issued to the Washington facilities in mid-2011. The permits require the Washington dischargers to participate in the task force, described above, and to establish PCB limits. Monitoring PCBs will tell us what current levels of PCBs are being discharged and help to identify next steps for better treatment and operations.

Managing stormwater

Stormwater – or polluted runoff -- is what results when it rains hard or during a fast snow melt. The water carries pollution on the land into downstream waters. Stormwater is a leading contributor to toxic pollution problems in the Spokane River.

A typical storm drain with dirt and debris that winds up in lakes, streams and rivers.

The *Eastern Washington Phase II Stormwater General NPDES Permit* is Ecology's primary tool to prevent polluted runoff. Many communities are just now beginning to take the steps necessary to comply under this phase of the permit. Through this permit system, Ecology regulates stormwater discharges at industrial sites, construction sites that are one-acre and larger, sand and gravel sites, municipalities, and along state-owned highways. Municipalities covered by the stormwater permit are known as Municipal Separate Stormwater Sewer Systems (MS4s) and in Spokane include the city of Spokane, Spokane County, the city of Spokane Valley, and the Washington State Department of Transportation, which is covered by a separate Municipal Stormwater NPDES General Permit.

The following link provides more information on the stormwater general permit: www.ecy.wa.gov/programs/wq/stormwater/index.html

The majority of the stormwater entering the Spokane River is discharged by the city of Spokane. Significantly smaller volumes of stormwater are discharged by the city of Spokane Valley and Spokane County. A relatively small volume of stormwater also is discharged by Washington state highways and support facilities such as rest stops and truck scales.

Stormwater discharges from the city of Spokane also include combined sewer overflows (CSOs), which are regulated under the city's municipal wastewater permit. CSOs result when combined wastewater / stormwater pipes are overwhelmed with rain or snowmelt and the combined storm and wastewater is discharged directly into the Spokane River. The city of Spokane is on a schedule to significantly reduce all CSOs to the Spokane River by 2017. The city also is working through an "adaptive management plan," described below, to reduce PCBs in stormwater that goes to the Spokane River.

City of Spokane Stormwater PCB Adaptive Management Plan

In response to a settlement agreement reached with the Spokane Riverkeeper, the city of Spokane developed an adaptive management plan to specifically address PCBs in its stormwater discharges. The city worked with the Riverkeeper and Ecology to develop the plan. The purpose of this adaptive management plan is to reduce PCBs in stormwater discharges, to comply with the city's stormwater NPDES permit and the CSO sections of its wastewater treatment plant permit. By following this plan, the city will reduce PCB discharges as much as possible by:

1. Analyzing, organizing, and interpreting existing PCB sampling data as it relates to the city's stormwater NPDES permit.

2. Identifying likely sources of PCBs and prioritizing appropriate remedial actions to be accomplished and best management practices to be followed.

3. Developing and designing an adaptive approach for additional data collection and additional remedial actions that further reduce PCBs within the city and in the Spokane River for the long term.

Ecology is actively working with the city of Spokane and the Spokane Riverkeeper to ensure the plan requires sufficient accountability as well as coordination among the three parties for collecting and reporting on new data. All parties are interested in applying this plan wherever practical and logical to other pollutants and sources, such as the wastewater treatment system. This plan also will serve as a template for the other dischargers who will be developing and implementing similar plans as part of the work of the task force.

Toxics Cleanup Program

In addition to the cleanup projects already accomplished (see pages 9-12), more projects are planned for the future. These projects are designed to address heavy metals from Idaho's Silver Valley mining district. Each of these projects will be completed as Ecology secures adequate funding:

- Barker Road South. (This project is designed to restrict access to contamination.)
- Barker Road North
- Islands Lagoon
- Myrtle Point
- Flora Road Repair (This project is to repair damage to a previously completed site that was damaged during high river flows in 2011.)

Ecology plans to place a gravel cap over the affected sediments at most of the remaining sites, minimizing disturbance of existing vegetation and enhancing public access pathways.

Ecology plans to excavate and place a gravel cap over the affected sediments at most of the remaining sites, minimizing disturbance of existing vegetation and enhancing public access.

These additional projects also will help protect the Spokane River:

- **Aluminum Recycling Trentwood**. A Remedial Investigation and Feasibility Study is nearing completion for the Aluminum Recycling Trentwood site located near the river at 4323 N. Sullivan Rd. in the Spokane Valley. Recent studies indicate the main contaminants are aluminum sulfate and mineral oxides from aluminum sulfate production that occurred after about 1986. See this link for details: https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=1081

- **Holcim**. A Remedial Investigation and Feasibility Study are underway for the Holcim site located near the river at 12207 East Empire in the Spokane Valley. Cement kiln dust is the primary contaminant along with metals such as lead and arsenic are Investigations are covering approximately 11 acres. See this link for details: https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=4580

Hazardous Waste and Toxics Reduction

Inspections and Technical Assistance

The Hazardous Waste and Toxics Reduction Program conducts inspections of businesses and industrial facilities to make sure that hazardous (toxic) waste is being stored properly, labeled properly and disposed correctly to avoid polluting our soil and water. The program not only regulates toxic waste management, but also works with businesses and industries to eliminate hazardous materials from being generated in the first place.

The program is working with a team of local agencies providing support for a voluntary small business incentive program called EnviroStars™. The Spokane River Forum and Spokane Regional Health District visit small businesses and provide incentives to businesses if they manage their hazardous waste properly along with other environmentally sound practices.

Ecology's Spill Response Program's spill prevention and cleanup

Every year, more than 20 billion gallons of oil and hazardous chemicals are transported through Washington by rail, road, pipelines, barges and ships. Accidents, equipment failure, and human error can all lead to unintended and potentially disastrous consequences. Oil and chemical spills can kill fish, birds and wildlife, foul drinking water sources, contaminate beaches and soils, and close public access areas. All spills, whether on land or water, can threaten public health and safety as well as our environment – ultimately damaging the state's economy and quality of life.

Through the years, Ecology has responded to thousands of spills, accidents, fires, explosions and other incidents to protect public health, reduce environmental damages, and shield sensitive natural, cultural and economic resources. For example, if a truck crashes releasing fuel or other hazardous cargo into the river or over a shallow part of the aquifer, Ecology's Spokane spills team is called to the scene to analyze the incident's effects on the environment. Ecology's role is to make sure the spiller takes immediate steps to clean up the spill and prevent it from entering surface and underground water sources. If the oil or hazardous material is already in the water, Ecology makes sure those responsible are using techniques to contain the spill so it can be cleaned up as close to the site as possible.

Ecology works hard to make sure hazardous, toxic substances do not pollute the Spokane River or our aquifer. The mission of the Spill Prevention, Preparedness, and Response Program is to protect Washington's environment, public health, and safety through a comprehensive spill prevention, preparedness, and response program. The program focuses on preventing oil spills to

state waters and land – as well as planning effective responses to oil and hazardous material spills whenever they occur.

Communications

Ecology's Office of Communication and Education strives to keep the public informed by creating public documents that are available in both hard copies and on-line (such as this document). Communication managers in the Eastern Region Office of Ecology inform the public and the media by creating public news releases plus write-ups on Twitter, Facebook and on Ecology's and others' blog sites. Ecology's Eastern Regional Office also maintains two listservs that are used for relevant announcements. These efforts support Ecology's value that involving the public and keeping citizens well informed are vitally important when making public policy decisions about the environment.

Connecting people with tools

The following sections describe resources that are available to the public, small businesses, schools, and local governments to prevent toxic chemical pollution in the Spokane River basin.

Residents, businesses, and government

Washington Waters—Ours to Protect, Ecology's Water Quality Program--In Washington, we have dramatically reduced pollution from industrial facilities like manufacturing plants and sewage treatment plants. While our state isn't letting up on industrial pollution, we're now putting new emphasis on equipping Washington residents – all of us – to help protect our state's imperiled waters. People usually want to do the right thing, but they often do not know what that is. With Washington's growth and the issues we face in restoring our urban waters, this topic has never been more relevant. See our *Washington Waters – Ours to Protect* website for additional information: www.ecy.wa.gov/washington_waters/. Public education materials are available to adapt to local jurisdictions to help local governments get started.

Residents

- 1-800-RECYCLE-- Connects residents and businesses with a comprehensive database to locate safe disposal options for household chemicals, electronics, yard debris, and many other recyclables. Disposing these items properly keeps potentially toxic chemicals from entering our air and water. https://fortress.wa.gov/ecy/recycle/

- Toxic Free Tips-- This statewide program encourages the safe use and disposal of hazardous household products, and the use of safer alternatives. http://www.ecy.wa.gov/toxicfreetips/

- You can find consumer information about Washington's drug take back program at: http://www.medicinereturn.com/

- Washington now has a FREE, convenient and environmentally responsible recycling program for computers, monitors, laptops and televisions. Find out how to recycle your computers and other electronics: www.ecy.wa.gov/programs/swfa/eproductrecycle/

In the first two years of operation the manufacturer funded E-Cycle Washington program collected over 78 million pounds (39,000 tons) of televisions, computers and monitors for recycling.

Businesses

- **TREE** program-- Technical Resources for Engineering Efficiency (TREE) is a free, non-regulatory, confidential technical assistance program to reduce waste and increase profits. Since 1998, TREE has teamed with over 30 Washington industrial facilities to improve wastewater discharges, increase energy efficiency, and promote proper hazardous waste disposal and waste treatment. For example, if these manufacturers implemented the recommendations for dangerous waste each year, these **wastes would be reduced by 235,000 pounds annually**. Facilities can also elect to receive assessment of and recommendations for less toxic production chemicals, increased water efficiency, and reduced solid waste generation.

  The focus is on achieving payback periods specified by the company while reducing waste, i.e., the new equipment or operating technique will pay for itself in so many months. Since 1998, Ecology has worked with 30 select Washington businesses to reduce their environmental footprint and make them "greener." If the facilities implemented opportunities recommended, there would be a **total savings of $2.5 million per year**. For more information, see: www.ecy.wa.gov/tree/index.html or contact Scott Mallery, P.E. at 509-329-3473 or Lynn Coleman, P.E. at 360-407-6738.

- **Lean and Environment** program— Ecology's Hazardous Waste and Toxics Reduction Program and "Impact Washington" work together to provide low-cost "lean" manufacturing training, assessment and implementation assistance. Completed Lean and Green projects include:

  - Columbia Paint, a manufacturer of residential, architectural, and industrial paint and coatings in Spokane. Through this program, Columbia Paint cut its hazardous materials and waste by 17,600 pounds. They were able to increase production by 14 percent without adding additional staff.

  - AccraFab, a custom metal fabrication products and services company in Liberty Lake, was able to increase the efficiency of its metal finishing lines and reduce the time and costs spent on associated wastewater treatment. With help from Ecology and Impact Washington, AccraFab reduced acidic wastewater generation in that process by 73,000 gallons per year (94 percent). The company is saving more than $187,000 annually in avoided wastewater management and treatment costs.

  See www.ecy.wa.gov/programs/hwtr/lean/index.html for more information on Lean and Environment. Ecology has grant funding to defray costs of future projects and is actively looking for interested companies.

- Hazardous waste education and resources-- Ecology's Hazardous Waste and Toxics Reduction Program provides technical assistance and resources for businesses that generate dangerous waste. These resources include training materials that can be found online at: www.ecy.wa.gov/programs/hwtr/business.html

  Ecology has grant funding to defray costs of future projects and is actively looking for interested companies.

- Urban waters/local source control technical assistance-- Local source control specialists from the Spokane Regional Health District are working with businesses to identify and prevent pollution from reaching the river through sediment, storm drains, and combined sewers. Specialists visit businesses and work through a checklist of best management practices. Recommendations for improvements are made where needed and follow-ups may also be made to monitor progress and answer additional questions. The local source control specialists work alongside Ecology's Urban Waters investigators as they search for sources of toxic pollution along the river. See this website for details: www.ecy.wa.gov/urbanwaters/index.html

Working with educators

- Ecology is planning to conduct teacher training on the Hazards on the Homefront—a teacher's guide that integrates state and local information relevant to everyday activities at school and home, and in students' communities. This curriculum teaches about the connection between human health and our air, land, and water. See: www.ecy.wa.gov/hazardsonthehomefront/index.html

Citizen Groups

- Public Participation Grants provide funding to not-for-profit public interest organizations and citizen groups. These grants encourage public involvement in monitoring the cleanup of contaminated sites and pollution prevention through waste reduction and elimination.

  Many past recipients of these grants have addressed toxics in the Spokane River. www.ecy.wa.gov/programs/swfa/grants/ppg.html

- Staff members at Ecology will make themselves available, as time permits, to speak on topics addressed in this strategy.

  The Spokane River Forum, www.spokaneriver.net will conduct workshops in May of 2011 and again in 2012 regarding the toxic pollution challenge. Ecology staff plans to participate in these workshops and other community events as much as possible as a community dialog is a high priority for us.

Ecology Studies

The following is the bibliography of scientific studies on Spokane River toxics by Ecology's Environmental Assessment Program through 2012:

URL	Pub. No.	Title	Author	Year
https://fortress.wa.gov/ecy/publications/SummaryPages/84e30.html	84-e30	PCBs in Fish Taken from the Spokane River	Joy, J.	1984
https://fortress.wa.gov/ecy/publications/SummaryPages/857.html	85-7	Basic Water Monitoring Program: Fish Tissue and Sediment Sampling for 1984	Hopkins, B, D. Clark, M. Schlender, and M. Stinson	
https://fortress.wa.gov/ecy/publications/SummaryPages/91e14.html	91-e14	Basic Water Monitoring Program: Fish Tissue and Sediment Sampling for 1989	Hopkins, B	
https://fortress.wa.gov/ecy/publications/SummaryPages/9499.html	94-99	Cadmium, Copper, Mercury, Lead, and Zinc in the Spokane River: Comparisons with Water Quality Standards and Recommendations for Total Maximum Daily Loads	Pelletier, G.	1994
https://fortress.wa.gov/ecy/publications/SummaryPages/94e05.html	94-e05	1994 Spokane River Survey - Fish Tissue and Sediment Sampling Plan.	Davis, D.	1994
https://fortress.wa.gov/ecy/publications/SummaryPages/94e23.html	94-e23	Planar PCBs in Spokane River Fish. Memo to Carl Nuechterlein, ERO.	Johnson, A.	1994
https://fortress.wa.gov/ecy/publications/SummaryPages/94e24.html	94-e24	Results of 1993 Screening Survey on PCBs and Metals in the Spokane River	Johnson, A., D. Serdar, and D. Davis	1994
https://fortress.wa.gov/ecy/publications/SummaryPages/94e41.html	94-e41	PCB and Lead Results for 1994 Spokane River Fish Samples	Johnson, A.	1994
https://fortress.wa.gov/ecy/publications/SummaryPages/94154.html	94-154	Survey of Chemical Contaminants in Ten Washington Lakes	Serdar, D., A. Johnson, and D. Davis	

URL	Pub. No.	Title	Author	Year
https://fortress.wa.gov/ecy/publications/SummaryPages/95310.html	95-310	Department of Ecology 1993-94 Investigation of PCBs in the Spokane River	Toxic Investigation Section	1995
https://fortress.wa.gov/ecy/publications/SummaryPages/95356.html	95-356.	Washington State Pesticide Monitoring Program: 1993 Fish Tissue Sampling Report.	Davis, D., A. Johnson, and D. Serdar	
https://fortress.wa.gov/ecy/publications/SummaryPages/95e19.html	95-e19	Bioassays of Spokane River Sediments (Final).	Batts, D. and A. Johnson	1995
https://fortress.wa.gov/ecy/publications/SummaryPages/96e05.html	96-e05	Particulate Matter and Polychlorinated Biphenyls in Spokane River, Washington	Huntamer, D	
https://fortress.wa.gov/ecy/publications/SummaryPages/96331.html	96-331	Spokane River PCB Source Monitoring Follow-up Study November and December 1995	Golding, S.	1996
https://fortress.wa.gov/ecy/publications/SummaryPages/96e05.html	96-e05	Particulate Matter and Polychlorinated Biphenyls in Spokane River, Washington. Article in Microscope, Vol 44:1 1-6, 1996.	Huntamer, D.	1996
https://fortress.wa.gov/ecy/publications/SummaryPages/97e02.html	97-e02	Metal Concentrations in the Spokane River During Spring 1997. Memo to J. Manning and C. Nuechterlein, August 26, 1997.	Hopkins, B. and A. Johnson	1997
https://fortress.wa.gov/ecy/publications/SummaryPages/97e04.html	97-e04	1996 Results on PCBs in Upper Spokane River Fish. Memo to C. Nuechterlein and D. Knight, Eastern Regional Office.	Johnson, A.	1977
https://fortress.wa.gov/ecy/publications/SummaryPages/98305.html	98-305	Washington State Pesticide Monitoring Program: 1996 Surface Water Sampling Report	Davis, D.	URL
https://fortress.wa.gov/ecy/publications/SummaryPages/98329.html	98-329	Cadmium, Lead, and Zinc in the Spokane River Recommendations for TMDL and Waste Load Allocations	Pelletier, G.	1998
https://fortress.wa.gov/ecy/publications/SummaryPages/99330.html	99-330	Metals Concentrations in Spokane River Sediments Collected with USGS in 1998	Johnson, A.	1999

URL	Pub. No.	Title	Author	Year
https://fortress.wa.gov/ecy/publications/SummaryPages/0003017.html	00-03-017	Results from Analyzing Metals in 1999 Spokane River Fish and Crayfish Samples	Johnson, A.	2000
https://fortress.wa.gov/ecy/publications/SummaryPages/0003021.html	00-03-021	Reconnaissance Survey on Metals, Semivolatiles, and PCBs in Sediment Deposits Behind Upriver Dam, Spokane River	Johnson, A.	2000
https://fortress.wa.gov/ecy/publications/SummaryPages/0003026.html	00-03-026	Data Appendix: Reconnaissance Survey on Metals, Semivolatiles, and PCBs in Sediment Deposits Behind Upriver Dam, Spokane River	Johnson, A.	2000
https://fortress.wa.gov/ecy/publications/SummaryPages/0003040.html	00-03-040	Results from Analyzing PCBs in 1999 Spokane River Fish and Crayfish Samples	Johnson, A.	2000
https://fortress.wa.gov/ecy/publications/SummaryPages/0103015.html	01-03-015	An Ecological Hazard Assessment for PCBs in the Spokane River	Johnson, A.	2001
https://fortress.wa.gov/ecy/publications/SummaryPages/0103016.html	01-03-016	Spokane River PCB and Source Survey, August 2000	Golding, S.	2001
https://fortress.wa.gov/ecy/publications/SummaryPages/0103019.html	01-03-019	Chemical Analysis and Toxicity Testing of Spokane River Sediments Collected in October 2000	Johnson, A. and D. Norton	2001
https://fortress.wa.gov/ecy/publications/SummaryPages/0203009.html	02-03-009	Spokane Area Point Source PCB Survey, May 2001	Golding, S	
https://fortress.wa.gov/ecy/publications/SummaryPages/0203039.html	02-03-039	Results of Sampling to Verify 303(d) Metals Listings for Selected Washington State Rivers and Creeks	Johnson, A. and S. Golding	
https://fortress.wa.gov/ecy/publications/SummaryPages/0203049.html	02-03-049	Analysis of Fish Tissue from Long Lake (Spokane River) for PCBs and Selected Metals	Jack, R. and M. Roose	2002
https://fortress.wa.gov/ecy/publications/SummaryPages/0603019.html	06-03-019	Washington State Toxics Monitoring Program: Toxic Contaminants in Fish Tissue and Surface Water in Freshwater Environments, 2003	Seiders, K., C. Deligeannis, and K. Kinney	

URL	Pub. No.	Title	Author	Year
https://fortress.wa.gov/ecy/publications/SummaryPages/0603024.html	06-03-024	Spokane River PCBs Total Maximum Daily Load Study (DRAFT report)	Serdar, D., K. Kinney, and P. Hallinan	2006
https://fortress.wa.gov/ecy/publications/SummaryPages/0603025.html	06-03-025	PCBs, PBDEs, and Selected Metals in Spokane River Fish, 2005	Serdar, D. and A. Johnson	2006
https://fortress.wa.gov/ecy/publications/SummaryPages/0603027.html	06-03-027	PBDE Flame Retardants in Washington Rivers and Lakes: Concentrations in Fish and Water, 2005-06	Johnson, A., K. Seiders, C. Deligeannis, K. Kinney, P. Sandvik, B. Era-Miller, and D. Alkire	
https://fortress.wa.gov/ecy/publications/SummaryPages/0703007.html	07-03-007	Measuring Mercury Trends in Freshwater Fish in Washington State: 2005 Sampling Results	Furl, C., K. Seiders, D. Alkire, and C. Deligeannis	
https://fortress.wa.gov/ecy/publications/SummaryPages/0703055.html	07-03-055	Spokane River PCB TMDL Stormwater Loading Analysis: Final Technical Report	Parsons and Terragraphics Inc.	2007
https://fortress.wa.gov/ecy/publications/SummaryPages/0903010.html	09-03-010	PBDE and Dioxin/Furans in Spokane Stormwater	Lubliner, B.	2009
https://fortress.wa.gov/ecy/publications/SummaryPages/0903020.html	09-03-020	PBT Trend Monitoring: Lead in Suspended Particulate Matter, 2008	Meredith, C. and C. Furl	
https://fortress.wa.gov/ecy/publications/SummaryPages/0903013.html	09-03-013	Washington State Toxics Monitoring Program: Trend Monitoring for Chlorinated Pesticides, PCBs, and PBDEs in Washington Rivers and Lakes, 2007	Sandvik, P.	
https://fortress.wa.gov/ecy/publications/SummaryPages/0903020.html	09--03-020	PBT Trend Monitoring: Lead in Suspended Particulate Matter, 2008	Meredith, C. and C. Furl	2009
https://fortress.wa.gov/ecy/publications/SummaryPages/0903108.html	09-03-108	Quality Assurance Project Plan: PBDE Flame Retardants in Spokane River Fish Tissues and Osprey Eggs	Furl, C., C. Meredith, and M. Friese	2009
https://fortress.wa.gov/ecy/publications/SummaryPages/1003015.html	10-03-015	PBT Monitoring: PBDE Flame Retardants in Spokane River Fish, 2009	Furl, C. and C. Meredith. 2010.	

URL	Pub. No.	Title	Author	Year
https://fortress.wa.gov/ecy/publications/SummaryPages/1003027.html	10-03-027	Washington State Toxics Monitoring Program: Trend Monitoring for Chlorinated Pesticides, PCBs, PAHs, and PBDEs in Washington Rivers and Lakes, 2008	Sandvik, P.	
https://fortress.wa.gov/ecy/publications/SummaryPages/1003034.html	10-03-034	Perfluorinated Compounds in Washington Rivers and Lakes.	Furl, C. and C. Meredith	
https://fortress.wa.gov/ecy/publications/SummaryPages/1003041.html	10-03-041	PBT Trend Monitoring: Measuring Lead in Suspended Particulate Matter from Washington State Rivers and Lakes, 2009 Results	Meredith, C. and C. Furl. 2010	
www.ecy.wa.gov/biblio/1103013.html	11-03-013	Spokane River PCB Source Assessment 2003-2007	Serdar, D., B. Lubliner, A. Johnson and D. Norton	

The Urban Waters Initiative staff has begun research on toxics to the Spokane River and published the following report:

https://fortress.wa.gov/ecy/publications/SummaryPages/1004027.html	10-04-027	Liberty Lake Source Trace Study Regarding PCB, PBDE, Metals, and Dioxin/Furan - A pilot project for Spokane Basin Source Tracing	Fernandez, A.	2010